

About 5 or 6 paces farther from the place where the sheep were lying, towards the north-west the ground was much torn up as if plough'd, and an oblique hole made of about three feet deep.

The breadths of the different holes were from six to three inches.

LIII. *A Letter from Mr. James Dodson to Mr. John Robertson, F. R. S. concerning an Improvement of the Bills of Mortality.*

S I R,

January 13, 1752.

Read Jan. 16,
1752.

AS there has lately been a scheme proposed for amending the form of the bills of mortality of London, in a pamphlet called *Observations on the past growth and present state of London*, by Mr. Corbyn Morris, the ingenious author of which has enumerated many excellent purposes, to which it may be applied, but has omitted to mention that of giving a greater degree of certainty to the calculations of the values of annuities on lives; a benefit too considerable to be passed by silently: And as your knowledge of that subject will enable you to judge of what is fit to be done, in order to obtain so desirable an advantage; I beg leave to trouble you with my thoughts concerning a farther regulation of those bills, which, I presume, may be conducive thereto.

The present possessors of intailed estates are, in common law, justly called tenants for life. Marriage-

riage-settlements, generally, convey the reversion of a considerable part of the bridegroom's estate to the bride, for her natural life after his decease; to which two things all the freehold estates in these kingdoms are liable: and if to these be added the great number of copyholds, determinable on lives; the great quantities of church, college, and other lands, leased on lives, and the estates possessed by ecclesiastical persons of all degrees; we shall find, that the values of the possessions and reversions, of much the greatest part, of the real estates in these kingdoms, will, one way or other, depend on the value of lives. Likewise the incomes annexed to all places, civil and military, all pensions, and most charitable donations, are annuities for life. The interest or dividends of many personalities in the stocks have been, by the wills of their possessors, render'd of the same kind; besides which, there are some annuities on lives, which have been granted by the government, and have parliamentary security for their payment; and others, that have been granted by parishes, in consequence of acts of parliament made for that purpose.

After this summary view of the extensive property, that is vested in annuities on lives, it would be very easy to name a great variety of circumstances, in which the computations of the values of one, two, or more lives, will become necessary to those persons, who do not chuse to have their property determined by customs, which seem to have been established merely for want of good methods of calculation. But I know to whom I am addressing,
and

and shall therefore forbear to exemplify on a subject, with which you are so well acquainted.

The advantages attending the determination of those things, by calculation, rather than by custom, being therefore considered as evident, it may seem strange, that, notwithstanding many of these tenures have subsisted from the very origin of private property in these kingdoms, yet we do not meet with so much as an attempt towards computing their values, till that of the late justly celebrated Dr. Halley, by the assistance of the bills of mortality of Breslaw in Silesia, which was soon followed by Mr. De Moivre's truly admirable hypothesis, that the decrements of life may be esteemed nearly equal, after a certain age.

It has been the opinion of some authors, that, since his hypothesis was originally derived from the Breslaw observations, it cannot be near so well adapted to the inhabitants of these kingdoms, as what has been derived from the bills of mortality of London. But this argument doth not, as I conceive, appear to be conclusive; first,

Because those bills, as hitherto kept, are not well adapted to answer this purpose.

Secondly, Because the manner, in which the inhabitants of London, and those of most of the country towns and villages, live, their occupations, diet, and diversions, nay the very air they breathe, are as different, as those of London, and Breslaw, can possibly be; and, consequently, so must the times of their dissolution. All which has been, with a great deal of clearness, evinced by the gentleman above quoted.

Thirdly,

Thirdly, because those persons, who suppose, that Mr. De Moivre's hypothesis has its foundation, peculiarly, in the Breslaw observations, are greatly mistaken: for, having lately been endeavouring to discover some farther helps to the speedy valuation of lives, I have found, that, on the contrary, if the London observations had been then in Mr. De Moivre's hands, he might, as justly, have derived his hypothesis therefrom; which will appear from his own words, in the preface to his treatise of *Annuities on Lives*, compared with the London observations.

“ Two or three years after the publication of the
 “ first edition of my *Doctrine of Chances* (says that
 “ excellent mathematician) I took the subject into
 “ consideration; and consulting Dr. Halley's table of
 “ observations, I found, that the decrements of life,
 “ for considerable intervals of time, were in arithmetic
 “ progression: for instance, out of 646 persons of 12
 “ years of age, there remain 640, after one year:
 “ 634, after two years; 628, 622, 616, 610, 604,
 “ 598, 592, 586, after 3, 4, 5, 6, 7, 8, 9, 10
 “ years respectively; the common difference of those
 “ numbers being 6. Examining afterwards other
 “ cases, I found, that the decrements of life, for
 “ several years, were still in arithmetic progression,
 “ which may be observed from the age of 54 to the
 “ age of 71, where the difference, for 17 years to-
 “ gether, is constantly 10. After having tho-
 “ roughly examined the tables of observations, and
 “ discover'd that property of the decrements of life,
 “ I was inclined to compose a table of the values of
 “ annuities on lives, by keeping close to the tables
 “ of observation; which would have been done
 “ with

“ with ease, by taking, in the whole extent of life,
 “ several intervals, whether equal or unequal. How-
 “ ever, before I undertook the task, I tried what
 “ would be the result of supposing those decre-
 “ ments uniform from the age of twelve; being
 “ satisfied, that the excesses on one side would be
 “ nearly compensated by the defects on the other :
 “ then, comparing my calculation, with that of Dr.
 “ Halley, I found the conclusion so very different,
 “ that I thought it superfluous to join together several
 “ different rules, in order to compose a single one.”

Now the same thing, which Mr. De Moivre mentions above, happens in the table of the London observations; *viz.* out of 510 persons, of 12 years of age, there remain 504, after one year; 498, after two years; 492, 486, 480, 474, 468, 462, after 3, 4, 5, 6, 7, and 8 years respectively; the common difference being 6; and the like happens in other instances, to be met with in the London observations, as published by different authors. Add to this, that, having calculated the value of an annuity on a life of 10 years of age, by both tables, and also by the hypothesis, I find it to turn out thus,

	Years Purchase.
By the Breslaw tables of observations	17,7237
By supposing the decrements of life equal	16,8814
By the London tables of observations	16,3907

From which there seems to be some reason to conclude, that the hypothesis (as it gives an answer less than the Breslaw, and greater than the London observations) may be the best method of the three; And it is farther remarkable, that the result, by the

hypothesis, is nearer to that by the London, than to that by the Breslaw observations.

However, if the argument for using the London observations has any force at all, the computation of the value of each person's life must be made from observations, drawn from the bills of mortality, kept at the place of his or her residence: and therefore it is, that I at present trouble you, in order to contribute, as much as I can, to there being a sufficient number of good bills of mortality.

There seems to be an objection, both to the hypothesis, and to the observations; for it is well known, that the fair sex (especially at two periods of their life) are obnoxious to fatal disorders, not incident to the other sex, nor distinguished in the present bills of mortality; and, consequently, neither the tables of observations, nor the hypothesis (which is derived from them) will render the calculations of the values of lives sufficiently certain; unless there be a periodical distinction of sexes in those bills: as it would probably appear, if such a distinction had been introduced, that there is a wide difference between the values of a male and female life of the same age.

But there will be a great inconvenience, in rejecting the hypothesis, which none of these gentlemen have remedied; I mean the prolix and laborious computation hitherto directed for the finding the values of lives from tables of observations: whereas, by the hypothesis (as its author justly observes) more can be concluded in a quarter of an hour, than can be performed in a quarter of a year, by any method, which the others have demonstrated. Whence it may be presumed, that the hypothesis will continue

to be used, until better methods are substituted in the place of those derived from it.

When the bills of mortality, digested into a proper form, shall have been kept a convenient time in every city or considerable town, and also in every hundred, or other proper division, of the country (and this I should be glad to see done) then, and not till then, the hypothesis may be tried by the facts, that will appear from the bills, and be confirmed or rejected accordingly.

Indeed (for my own part) I am almost persuaded, from what has been above remarked, that the hypothesis will, in general, appear to be the nearer the truth, the more those bills of mortality shall be in number, and the correcter they are kept. I shall proceed, therefore, to mention those alterations, which, I think, may be of advantage, in the form of the bills of mortality, in every part of these kingdoms, over and above those mentioned by Mr. Morris, in the before-quoted pamphlet.

1. That there be a distinction made, upon the face of the bills of mortality, between the persons who were born in the place where such bills were kept, and those that were not. This will be effected with a very little trouble, if the searchers of each parish be instructed to ask the question of the friends of the deceased, and annex the answer to their report. This precaution will facilitate many of the good purposes proposed by Mr. Morris; and, in particular, with regard to the fixing the values of lives, it will enable the persons, who shall apply the bills to calculation, to draw their conclusions only from the lives, that were both begun, and ended, in or

near the same place ; the want of the possibility of doing which is the principal objection to the London bills, as hitherto kept.

2. That there be a distinction, with regard both to age and disease, made upon the face of the bills, between the sexes ; and that one case be added to the list of diseases ; *viz.* complaints peculiarly incident to the female sex. This will not only solve the difficulty above started, but also answer many purposes in political arithmetic, as well as to the sagacious physician.

3. That a farther division be made in time ; for whereas Mr. Morris's scheme exhibits no age between 40 and 50, I would propose, that the numbers dying between 40 and 45, and between 45 and 50, should be particularized in the bills ; the design of this being to fix the periods, that are fatal to the fair sex, with more certainty.

These alterations, together with those proposed by Mr. Morris, being made, the yearly bill of mortality, for London, will appear as in the specimen annexed.

Now, Sir, if you shall, upon considering what I have offered, be of opinion, that the above regulations are worthy notice, your approbation will be a sufficient justification of my desire, that they may be made more public, in such manner as you shall think fit. I am, Sir,

Your most humble servant,

James Dodson.

fease, within the City and Suburbs

Total
of all
Ages.

Natives.

Others.

Of the Natives of *London* have died of the following respective Annual Births; viz.

BIRTHS.

Years inclusive.

Beyond 1651
1651 to 1660
1661 to 1670
1671 to 1680
1681 to 1690
1691 to 1700
1701 to 1705
1706 to 1710
1711 to 1720
1721 to 1730
1731 to 1735
1736 to 1740
1741 to 1745
1746
1747
1748
1749
1750

Total —

Pleurisy.	Males																		
	Females																		
Teeth.	Males																		
	Females																		
Thrush.	Males																		
	Females																		
Casualties, Bruised, Burnt, Choaked, Drowned, Executed, Self-murdered, Murdered, Overlaid, Poisoned, Scalded, Shot, Strangled, Smothered, Starved, and Suffocated.	Males																		
	Females																		
Totals of each Age.	Males																		
	Females																		

Total Number of BIRTHS ———
Of which { Males ———
 { Females ———

A GENERAL BILL of the WEDDINGS, BIRTHS, and BURIALS; and also of the Numbers, which have died of each Age, Sex, and Disease, within the City and Suburbs of London (distinguishing which were Natives thereof) for the Year ending December the 31st 1750.

Total Number of BURIALS.
Whereof have died of the following Ages and Sex:

		One Month old, and under.		From One to Three Months.		Three Months to One Year.		One Year to Two Years.		Two to Three.		Three to Four.		Four to Five.		Five to Ten.		Ten to Fifteen.		Fifteen to Twenty.		Twenty to Thirty.		Thirty to Forty.		Forty to Forty-five.		Forty-five to Fifty.		Fifty to Sixty.		Sixty to Seventy.		Seventy to Eighty.		Eighty to Ninety.		Ninety to One Hund.		Beyond One Hund.		Total of all Ages.								
		Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.	Natives.	Others.											
Abortive.	Males																																																	
	Females																																																	
Ague.	Males																																																	
	Females																																																	
Apoplexy, Palsy, Cramp, and suddenly.	Males																																																	
	Females																																																	
Asthma and Phthisic.	Males																																																	
	Females																																																	
Chin-cough, Whooping-cough, and Worms.	Males																																																	
	Females																																																	
Child-bed, Miscarriages, and Feminine Disorders.	Males																																																	
	Females																																																	
Colick, Gripes, Twisting of the Bowels, Flux, Vomiting, Looseness, Bloody-Flux, and Bleeding.	Males																																																	
	Females																																																	
Consumption, Jaundice, Diabetes, and Falling Sickness.	Males																																																	
	Females																																																	
Convulsions.	Males																																																	
	Females																																																	
Dropy, Tympany, Stoppage in the Stomach, Rising of the Lights, and Swelling.	Males																																																	
	Females																																																	
King's-Evil, Itch, Leprosy, Scurvy, St. Anony's Fire, Scald Head, Impostume, Sores, Ulcers, Cancer, Fistula, Gangrenes, and Mortifications.	Males																																																	
	Females																																																	
French Pox.	Males																																																	
	Females																																																	
Small-Pox and Purples.	Males																																																	
	Females																																																	
	Males																																																	
	Females																																																	
Fevers, Calentures, Inflammations, Sore Throat, and Quinsy.	Males																																																	
	Females																																																	
Gout, Rheumatism, and Sciatica.	Males																																																	
	Females																																																	
Gravel, Strangury, and Stone.	Males																																																	
	Females																																																	
Rickets, and Infantine Disorders in the Head, Liver, Groin, and Ruptures.	Males																																																	
	Females																																																	
Lethargy, Grief, Lunatic, Vapours, Megrims, Spleen, Head-ach, Blasted, Planet-struck, and Bed-ridden.	Males																																																	
	Females																																																	
Measles, Chicken-pox, Swine-pox, and Rash.	Males																																																	
	Females																																																	
Pleurisy.	Males																																																	
	Females																																																	
Teeth.	Males																																																	
	Females																																																	
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	Females																																																	
Totals of each Age.	Males																																																	
	Females																																																	

Of the Natives of London have died of the following respective Annual Births; viz.

BIRTHS.	
Years inclusiv.	
Beyond 1651	—
1651 to 1660	—
1661 to 1670	—
1671 to 1680	—
1681 to 1690	—
1691 to 1700	—
1701 to 1705	—
1706 to 1710	—
1711 to 1720	—
1721 to 1730	—
1731 to 1735	—
1736 to 1740	—
1741 to 1745	—
1746	—
1747	—
1748	—
1749	—
1750	—

Total —

Total Number of BIRTHS — —
Of which { Males — —
 { Females — —

Total Number of WEDDINGS — — — —
Sickned of the Small-Pox { Inoculated — —
 { Not Inoculated — —

Total Number of BURIALS — — — —
Of which { Males — — — —
 { Females — — — —

FOUNDLINGS received — — — —